

**Annual Update**

<b>Kentucky Science and Engineering Foundation (KSEF)</b>
---

**Submitted to:**

**Kentucky Council on Postsecondary Education**

**Submitted by:**

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## Kentucky Science and Engineering Foundation

Under the Kentucky Innovation Act, the General Assembly directed the Kentucky Science and Technology Corporation (KSTC) to create and manage the Kentucky Science and Engineering Foundation (KSEF) as a means to increase Kentucky's capacity to become a leader state in competitive research by making its own investments in peer-reviewed science and engineering research and by attracting more research funding from all sources to the Commonwealth.

The Foundation is operated by KSTC through a contract with the Council on Postsecondary Education. KSTC is a nonprofit enterprise founded in 1987 to enhance the capacity of people, firms and organizations to use science and technology and effectively compete in the global marketplace.

Modeled in part on the National Science Foundation, KSEF invests in people and their ideas. KSEF provides funding in many research areas. The five research focus areas in which KSEF invests are Biosciences, Environmental and Energy Technologies, Human Health Development, Information Technology and Communications, and Materials Science and Advanced Manufacturing. These research areas have been identified as the priority focus areas by the Office for the New Economy of the Commonwealth of Kentucky.

KSEF only provides seed funding to catalyze emerging opportunities necessitating awardees to seek additional funds from other sources for continuation of the project. Its investments promote advances in existing and new technologies. Similar to NSF, KSEF invests in people and in their ideas. Its investment in research will expand the use of the infrastructure developed through the Kentucky Experimental Program to Stimulate Competitive Research (EPSCoR) Program.

KSEF initiates and supports:

- Emerging ideas, advanced scientific research and applied research,
- Programs, such as SBIR/STTR Phase Zero and Double Zero, to seek federal funds to develop and strengthen scientific and engineering technology,
- Training of graduate students and post doctoral scientists in all fields of science and engineering to enable human resource development,
- Programs to provide opportunity for Kentucky teachers to enhance their capacity in learning about advances in science and engineering, and
- Development of an information resource center on science and engineering to disseminate appropriate information to all stakeholders.

Development of intellectual property, integration of research and education, and development of collaborative projects are of paramount importance to KSEF to achieve its mission. Therefore, every dollar KSEF spends is an investment in people. KSEF has supported more than 300 scientists and engineers who in turn are training graduate students, researchers and postdoctoral students, developing intellectual capital and forming mutually beneficial partnerships. It is envisioned that KSEF-funded research will provide a rich foundation for broad and useful applications of knowledge and the development of new technology.

### 1. KSEF PROGRAM PRIORITIES

Initially, a series of four KSEF program priorities were established by KSTC Board of Directors upon recommendation of the KSEF Executive Director with input from the KSEF Advisory Board. The programs include:

**R&D Excellence** - purpose is to achieve excellence in science and engineering and allow innovation and technology development in existing and emerging areas of research by making

proactive investments through a peer-reviewed competitive selection process (see Section 2-5 and the KSEF website at <http://ksef.kstc.com>);

**Human Resource Development** – purpose is to build and retain excellent human capital by providing appropriate science and engineering training to students through creative programs, and by enhancing the knowledge and skill set of the providers through on-site short courses (see Section 6);

**Technology Capacity Building** – purpose is to build and enhance capacity in developing intellectual property and technology portfolio, and understanding of the technology transfer process and federal programs for small businesses (see Section 7); and

**Information Resources Center** – purpose is to become a one-step information resource center by gathering and disseminating the information on science and engineering in Kentucky.

## **2. KSEF R&D EXCELLENCE PROGRAM – 2006-07 AWARD PROCESS**

### **Issuance of Request for Proposals (RFP)**

Under the R&D Excellence Program, two RFP were issued during the fiscal year (FY2007): the first on June 23, 2006 (RDE-009), and the second one on April 19, 2007 (RDE-010). Proposals were solicited under the emerging ideas and emerging technologies grant categories from all Kentucky universities and colleges and high tech small businesses under RDE-009 solicitation, while only emerging ideas category proposals were solicited under RDE-010 solicitation. Proposals received in response to RDE-009 were reviewed by subject matter specialists and awarded after consideration and approval of the Executive Committee of the KSTC Board of Directors in December, 2006. Proposals received in response to the RDE-010 RFP are currently being processed and a decision on the awards will be made in FY2007-08.

KSTC's email database, that includes but is not limited to campus administrators, deans and chairs for all relevant departments and disciplines, was used for the RFP announcements. The RFPs were made available on the KSEF website (<http://ksef.kstc.com>). The announcements were also posted on the KSTC website ([www.kstc.com](http://www.kstc.com)), which is linked directly to the KSEF website. In addition, some of the primary recipients of KSTC email, such as university administrators, economic development agencies in the state and Chamber of Commerce, forward the RFP announcement email to people on their email databases. This assured a wide publicity of the available opportunity for submission of proposals for competitive awards.

### **Selection Process**

#### **The Peer Review Process**

A total of 566 professionals from around the world provided reviews for the proposals KSEF received this fiscal year. Reviewers were from academic institutions, governmental agencies and companies located in 44 states of the United States, Puerto Rico, Canada, Australia and 10 European, Asian and African countries. A minimum of three external reviews were produced for each proposal. The reviewers provided a numerical score and written comments for the five evaluation criteria on the technical content of the proposal. The reviewers were selected through contacts with 4,359 external experts. (Table 1).

**Table 1. KSEF Application and Award Process Highlights – 2006-2007 & Summary**

<b>R&amp;D Excellence Program</b>	<b>RFP Date</b>	<b>Application &amp; Approval</b>	<b>Letters of Intent (#)</b>	<b>Applicants (#)</b>	<b>Awards (#)</b>	<b>Peer Review (#)</b>	<b>Reviewers Contacted (#)</b>
RDE-009 Emerging Ideas & Technologies	Jun-23 2006	7-14-06 / 12-12-06	193 (177 invited)	141	16	566	4359
RDE-010 Emerging Ideas ONLY	Apr-19 2007	6-11-07/ TBD	94 (88 invited)	71			
<b>Totals from program inception in 2001 to June 30, 2007</b>			<b>1047</b>	<b>774</b>	<b>195</b>	<b>2,571</b>	<b>11,270</b>

**Peer Review Evaluation Criteria**

Each reviewer evaluated the proposal based on the following evaluation criteria.

**Rationale** – the degree to which the proposal provides a strong argument for the need to pursue the objectives proposed; also, if the proposal addresses an important issue, problem, or opportunity, as well as the quality of the evidence summarized (200 points).

**Scientific or Professional Merit** – the degree to which the activities proposed will advance the current state of knowledge and understanding in their own fields of study and across scientific fields (350 points).

**Innovativeness** – the degree of creativity and originality of the proposal, if new approaches to solving problems and exploiting opportunities in resource management or development, will be employed. Alternatively, to assess the degree to which the activity will focus on new types of important or potentially important resources and issues (250 points).

**Qualifications and Past Record of Investigators** – the degree to which the investigator or team of investigators are qualified to carry out the proposed activities; the category considers the authors experience as well as their record of achievements and prior findings (150 points).

**Facilities and Equipment** – the degree to which the investigators have secured access to the necessary facilities and equipment to conduct the proposed activities (50 points.).

**Selection Criteria**

Consideration was given to the quality of the research, the benefit to the state and the research focus in Kentucky when making awards. The following selection criteria were considered in conjunction with the technical reviews to select the winning proposals:

**Relevance to State's Priority Research Areas** – Projects demonstrating the greatest relevance to the current priority research areas of the Commonwealth of Kentucky.

**Kentucky Focus** – Projects with a focus on issues of relevance to the Commonwealth of Kentucky receive the greatest consideration.

**Soundness of Scientific Principles** – Soundness of approach and experimental design as judged by the external expert peer reviewers.

**New Innovation Opportunity** – The degree to which the project is likely to foster/sustain innovation and the potential impact it may have on the economic and/or societal well-being.

**Education and Dissemination** – The results of the project that may be broadly distributed resulting in greater public understanding of the problem. The information should be useful not

only to the scientific community but also to policy makers and stakeholder groups.

**Project Success** – Probability of success of the proposed project in a timely manner. Depending on the nature of the project, the project results in greater understanding of the problem or in the ultimate resolution of an identified problem.

**Appropriate Budget** – Appropriateness of the proposed budget given the level of effort proposed. Proposed costs must be reasonable in light of the anticipated project benefits.

**Performance Capability** – The prior experience and the resources of the applicant ensures their capability to perform the work being proposed.

**Appropriate Fit and Lack of Duplication** – The applicant shows originality of idea and how the proposed project complements, as appropriate, the previous, ongoing or other planned efforts. KSEF funds are not used to support a project currently funded through another source of state funds.

**Matching Funds** – **No matching funds**, cash or in-kind, are required or requested for projects funded under the R&D Excellence Program.

### **Recommendation/Approval Process**

#### **Kentucky Science and Engineering Foundation Advisory Board**

The KSEF Advisory Board (see Section 9 for a list of members), appointed by the KSTC Board of Directors and composed of scientists, engineers and administrators from academia and corporate sectors in Kentucky and other states, reviews the KSEF Executive Director's recommendations for the awards. The Advisory Board concurs or suggests changes when necessary. Prior to the approval of 16 KSEF awards by the KSTC Board of Directors during this past year, the KSEF Advisory Board met on December 8, 2006 to consider the award recommendations from the Executive Director that were based on the professional and impartial peer review and according to the recommendation process followed by the Foundation. The Advisory Board made sure that the final recommendations to the KSTC Board of Directors were based on the technical merit.

#### **Kentucky Science and Technology Corporation Board of Directors**

Based upon the recommendations of the Executive Director of KSEF and its Advisory Board, the KSTC Board of Directors approved 16 awards on December 12, 2006 under the R&D Excellence Program. After approval by the KSTC Board of Directors, KSEF announced the awards through a posting on the KSTC and KSEF websites. Awardees were informed by email.

### **3. R&D EXCELLENCE PROGRAM – 2006-2007 AWARDS**

Because it is difficult to predict discovery or anticipate all of the opportunities that fresh discoveries will produce, KSEF's portfolio must be broad and diverse, addressing many fields and activities. Awards are made for the most promising ideas as selected through merit review of competitive proposals for new and emerging opportunities within and across all fields of science and engineering (i.e. in five research focus areas).

**The 2006-07 Performance**

Sixteen (16) awards were made in four of the five State's designated Priority Research Focus Areas (Tables 1 & 2). All sixteen (16) awards were made effective January 1, 2007, with an award term of two years.

Of these awards, 14 were made for feasibility of new ideas that could lead to developing preliminary data (Emerging Ideas). The data would allow the researchers to write competitive proposals for large federal funds. Two awards were made to conduct applied and advanced research (Emerging Technologies). This research is expected to develop intellectual property and technologies of commercial potential for further development.

**Table 2. R&D Excellence Awards Made During FY2006-07**

<b>Research Categories:</b>	<b><i>Emerging Technologies</i></b>	<b><i>Emerging Ideas</i></b>	<b>Total (n)</b>	<b>Total Awarded KSEF Budget</b>	<b>Distribution of KSEF Budget</b>
<i>Biosciences</i>	1	5	6	\$505,114	35%
<i>Environmental &amp; Energy Technologies</i>	0	1	1	\$49,469	4%
<i>Human Health &amp; Development</i>	0	2	2	\$187,438	13%
<i>Information Technology &amp; Communications</i>	0	0	0	\$0	0%
<i>Materials Science &amp; Advanced Mfg.</i>	1	6	7	\$684,531	48%
<b>TOTAL</b>	<b>2</b>	<b>14</b>	<b>16</b>	<b>\$1,426,552</b>	<b>100%</b>
Total Awarded KSEF Budget	\$199,650	\$1,226,902		\$1,426,552	
Distribution of KSEF Budget	14%	86%		100%	

A list of the 16 funded projects along with the name of the investigators is provided in The Portfolio of Projects and Investments Attachment. The awardees include researchers from the University of Kentucky (14), University of Louisville (1) and Pikeville College (1).

**Definition of Research Categories**

KSEF has two research categories under which investigators can apply:

### Emerging Technologies

This grant category encompasses several stages of research on the way toward developing a product or process that will likely be packaged as a new 'technology'. These stages include: research activity to explore the application of a technical or biotechnical solution and early feasibility research of a new technology or process for a targeted purpose. The results of such projects will produce new technologies and set the stage for technology transfer activity. The average award size range for Emerging Technologies is \$20,000 - \$50,000 per year. Matching funds are not required or requested. The award period ranges from one to two years. The category is open to universities and colleges and small businesses.

### Emerging Ideas

This category encompasses research activity undertaken as preliminary work on high-risk, untested, novel ideas and to advance basic research to understand the causes, effects or relationships between various components of a topic. Project results are likely to be used in competing for federal funds and in early publication of new concepts. This new knowledge will advance the education of students, create intellectual property and allow researchers recognition as pioneers in a potentially new area. This is a high-risk investment in making Kentucky a leader state in coming years. The average award size range for Emerging Ideas is \$15,000 - \$50,000 per year. Matching funds are not required or requested. The award period ranges from one to two years. The category is open to university and college faculty, but not to small businesses.

## 4. KSEF R&D EXCELLENCE PROGRAM – AN INSIGHT

Similar to the trends showing in previous years, more than 80% of the proposals and funds awarded were in the Materials Science and Advanced Manufacturing (48%) and Biosciences (35%) focus areas, combined. Other highly competitive projects were awarded in the areas of Human Health and Development (13%) and Environmental & Energy Technologies (3%). (see Figure 1 below).

**Figure 1. R&D Excellence Awards 2006-2007 by Focus Area**

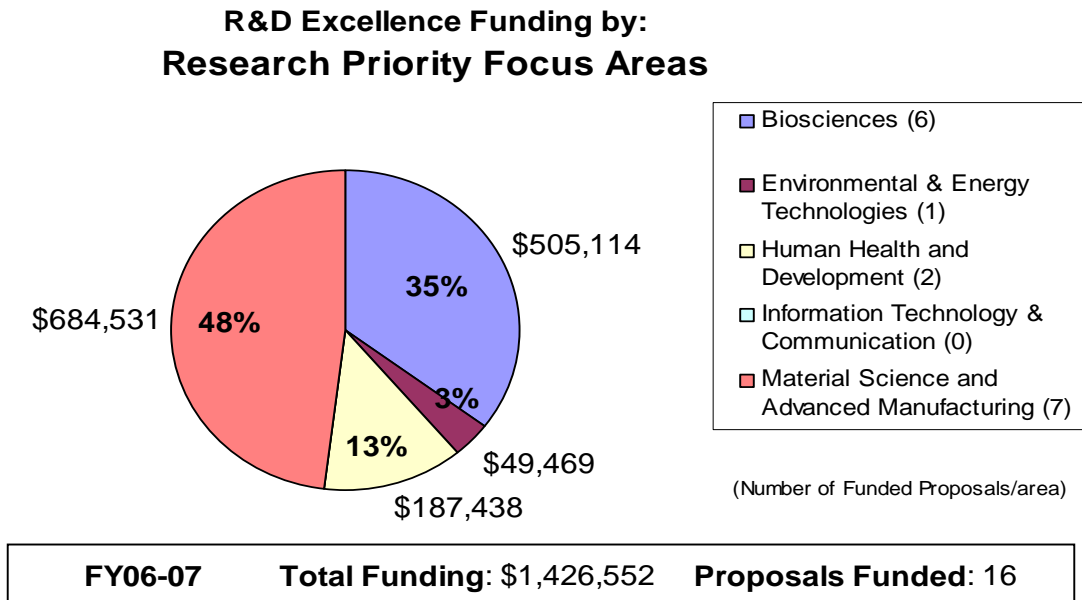


Table 3 below shows the breakdown of RDE-009 applications and awards by focus areas and organizations. In this round, 83 applications were received from the University of Kentucky, 42 from the University of Louisville, five from Western Kentucky University, three from Northern Kentucky University, two from Morehead State University, and one each from Pikeville College and Bluegrass Community and Technical College. In addition, four applications were submitted by small businesses. These results represent a steady increase in the number of applications received between ten and 15% over the applications received in prior years (e.g. 109 and 129 applications were received in FY2004-05 and FY2005-06, respectively).

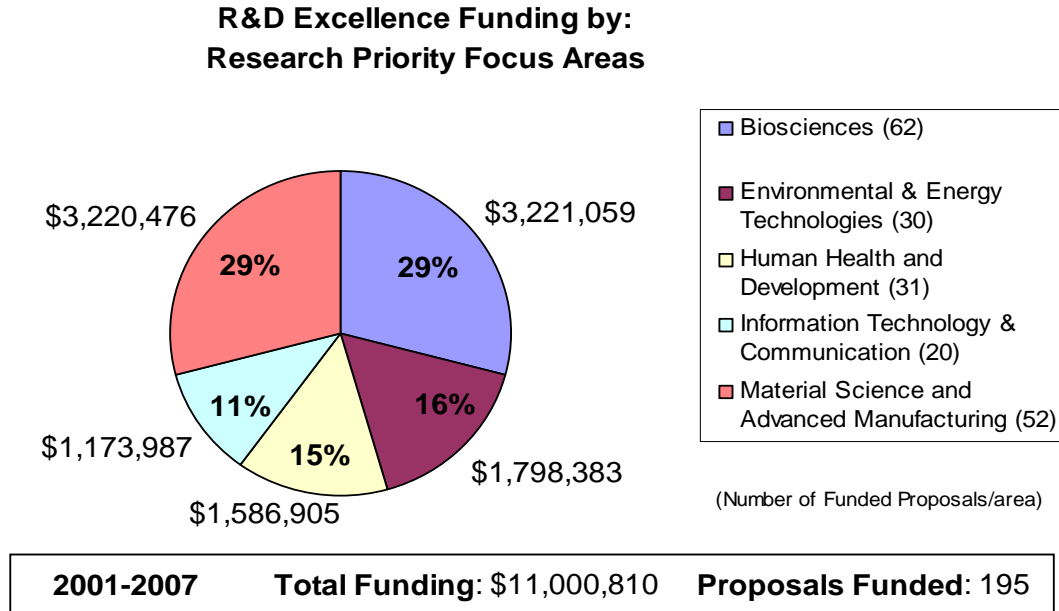
**Table 3. R&D Excellence Award FY2006-07: Number of applications, awards, and funds awarded by focus area and organization**

Focus Area	Orgnaization	Applications	Awards	Budget_Requested	Amount_Awarded
Biosciences	Business	1		\$49,200	
Biosciences	Bluegrass CTC	1		\$91,172	
Biosciences	Morehead	1		\$99,569	
Biosciences	Pikeville	1	1	\$100,000	\$35,000
Biosciences	UK	22	5	\$2,052,063	\$470,114
Biosciences	UofL	11		\$934,252	
Biosciences	WKU	1		\$60,000	
	<b>Sub-Total:</b>	<b>38</b>	<b>6</b>	<b>\$3,386,256</b>	<b>\$505,114</b>
Environ & Energy Tech	UK	12		\$897,412	
	<b>Sub-Total:</b>	<b>12</b>	<b>0</b>	<b>\$897,412</b>	<b>\$0</b>
Human Health & Develop.	Business	1		\$51,175	
Human Health & Develop.	UK	17	1	\$1,638,085	\$49,469
Human Health & Develop.	UofL	18		\$1,513,628	
Human Health & Develop.	WKU	2		\$127,579	
	<b>Sub-Total:</b>	<b>38</b>	<b>1</b>	<b>\$3,330,467</b>	<b>\$49,469</b>
Information Tech & Comm	Business	2		\$199,360	
Information Tech & Comm	Morehead	1		\$41,200	
Information Tech & Comm	UK	8	1	\$647,855	\$88,468
Information Tech & Comm	UofL	8	1	\$699,695	\$98,970
Information Tech & Comm	WKU	2		\$111,720	
	<b>Sub-Total:</b>	<b>21</b>	<b>2</b>	<b>\$1,699,830</b>	<b>\$187,438</b>
Materials Science & Manuf	NKU	3		\$144,968	
Materials Science & Manuf	UK	24	7	\$2,334,912	\$684,531
Materials Science & Manuf	UofL	5		\$497,141	
	<b>Sub-Total:</b>	<b>32</b>	<b>7</b>	<b>\$2,977,021</b>	<b>\$684,531</b>
<b>TOTAL FY05-06</b>		<b>141</b>	<b>16</b>	<b>\$12,290,986</b>	<b>\$1,426,552</b>
		<b>Applications</b>	<b>Awards</b>	<b>Budget_Requested</b>	<b>Amount_Awarded</b>
<b>TOTAL FY01-02 - FY06-07</b>		<b>703</b>	<b>195</b>	<b>\$51,331,456</b>	<b>\$11,000,810</b>

Figure 2 below represents the distribution of awards by focus area since the inception of the KSEF program, (2001 to June 30, 2007). Approximately, 60% of KSEF awards (and funds) were made in two focus areas: Biosciences and Materials Science and Advanced Manufacturing. About 40% of awards (and funds) were made in the remaining three focus areas.

**Figure 2. R&D Excellence Awards 2001-2007 by Focus Area**

Totals from program inception in 2001 to June 30, 2007



For FY2006-07, ninety-one percent (91%) of the total KSEF award funds were awarded to the University of Kentucky. The University of Louisville received seven percent % of the total award amount, and Pikeville College received two percent (see Figure 3).

**Figure 3. R&D Excellence 2006-07 Awards by Organization**

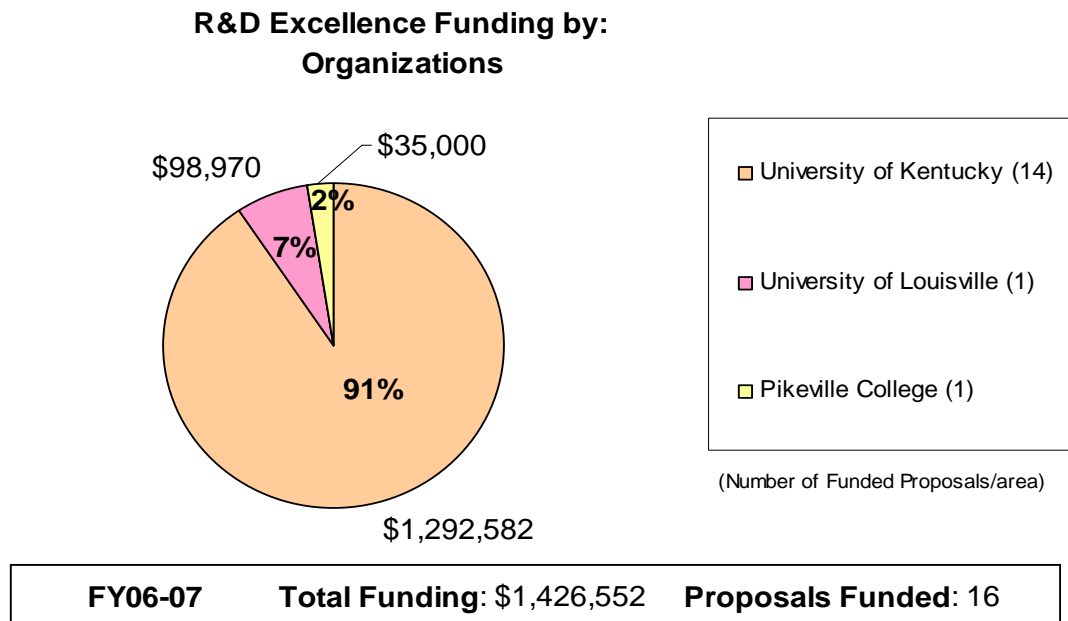
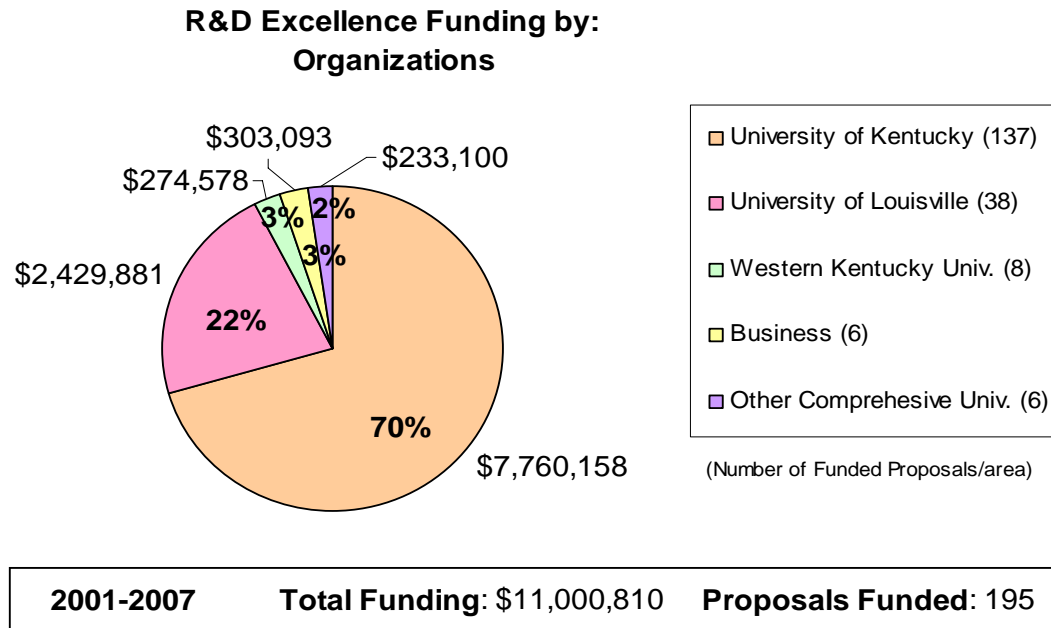


Figure 4 is a representation of the disbursement of RDE-009 awards and funds among colleges and universities in the Commonwealth of Kentucky. Since the inception of the program in 2001, the number of comprehensive Universities presenting competitive proposals and being awarded funds has increased (14 awards for six percent of funds disbursed). The Universities of Kentucky and Louisville received the largest shares (92% combined).

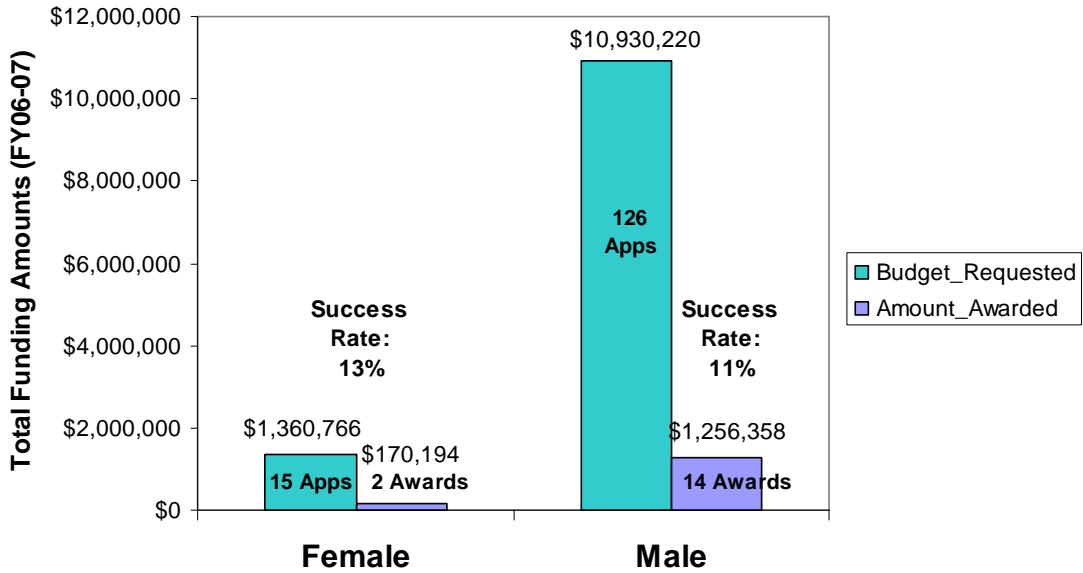
**Figure 4. R&D Excellence Awards by Organization**

Totals from program inception in 2001 to June 30, 2007



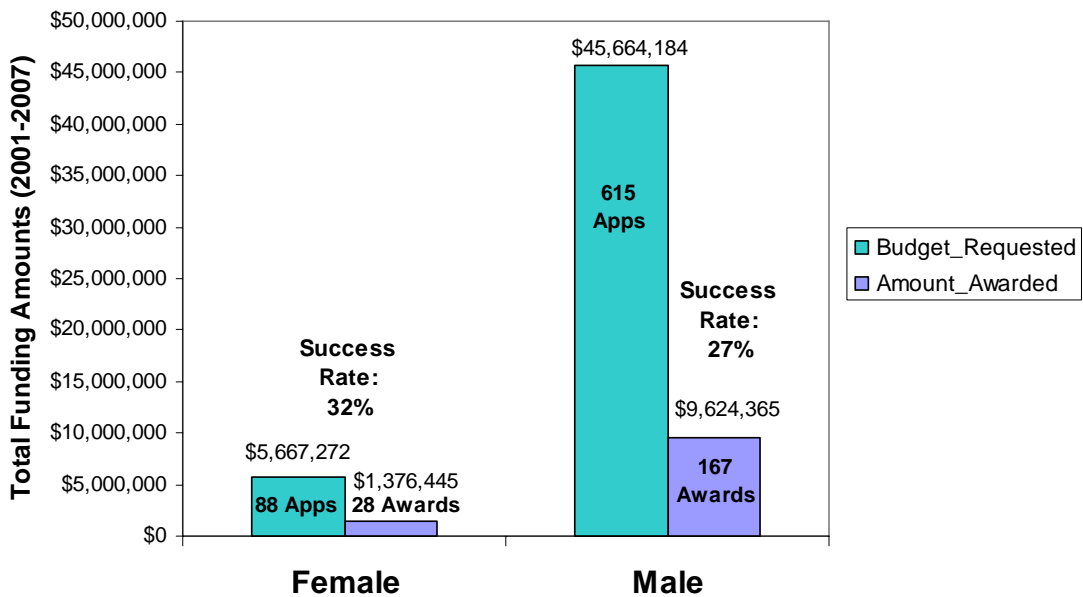
The breakdown of the number of applications received and awarded by gender is presented in Figure 5. In the RDE-009 round (FY2006-07), over eight times as many men as women applied for funding from KSEF. Nevertheless, the rate of success for women was higher than for men, but differed only by two points.

**Figure 5. R&D Excellence Applications and Awards by Gender in FY2006-07**



As observed for the current fiscal year, the number of applications received from men since the inception of the KSEF program is more than eightfold that of women. Nevertheless, the rate of success for women was slightly higher than for men by five percentage points.

**Figure 6. R&D Excellence 2001-2007 Applications and Awards by Gender**



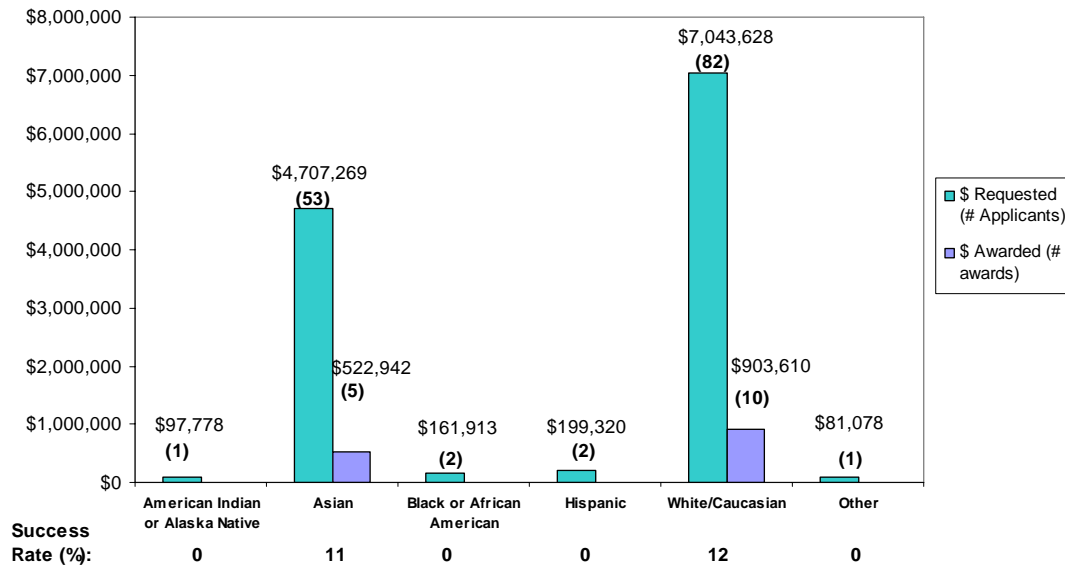
In FY2006-07 a majority of applicants and awardees were either white/Caucasian (82 applicants) or Asian (52 applicants). The remaining applicants were Hispanic, Black,

American Indian/Alaska Native or did not designate their race. The success ratio for winning awards for the two main groups was 11% for Asian applicants and 12% for White/Caucasian applicants (Figure 7). The definitions used for selecting ethnicity/race were as follows:

**Ethnicity/Race Definitions Used as Established by the National Science Foundation:**

- \* **Hispanic or Latino:** A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race.
- \* **American Indian or Alaska Native:** A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.
- \* **Asian:** A person having origins in any of the original peoples of the Far East, Southeast Asia or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand and Vietnam.
- \* **Black or African American:** A person having origins in any of the black racial groups of Africa.
- \* **Native Hawaiian or Other Pacific Islander:** A person having origins in any of the original peoples of Hawaii, Guam, Samoa or other Pacific Islands.
- \* **White/Caucasian:** A person having origins in any of the original peoples of Europe, the Middle East or North Africa.
- \* **Other:** This category is for individuals who do not feel the above categories offer an adequate description of their heritage or who have an alternate reason for not selecting one of the above.

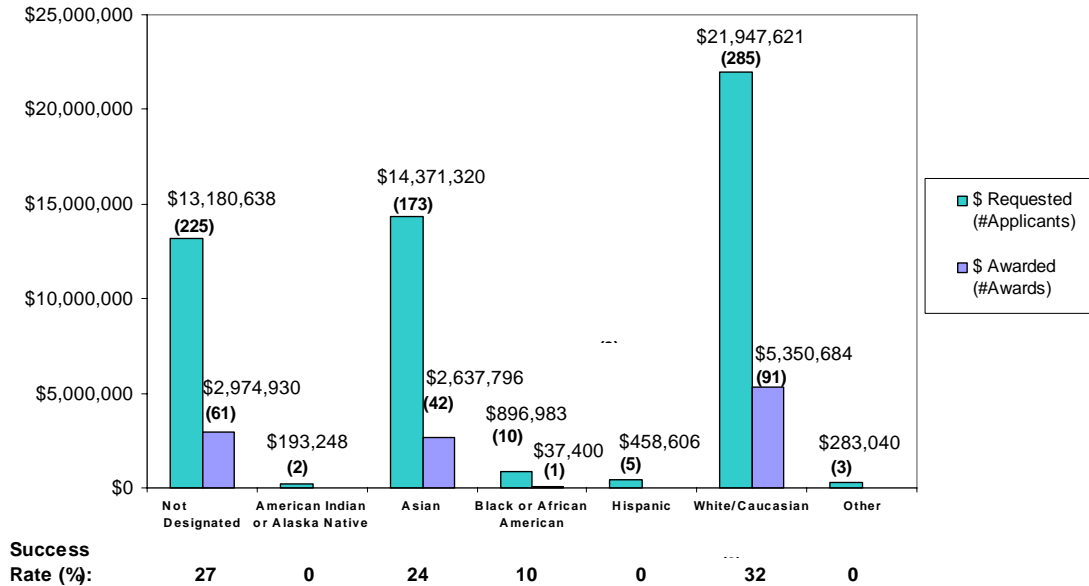
**Figure 7. R&D Excellence Applications and Awards by Ethnicity in FY2006-07**



Over the lifespan of the R&D Excellence funding, the ethnicity of the applicants reflects a trend similar to that shown for FY2006-07. Whites and Asians compromise the largest groups of applicants and awardees with a success rate of 32% and 24% respectively. However, Black and

African Americans represent a minority, showing a success ratio of 10% with one award from ten applications (see Figure 8).

**Figure 8. Distribution of Cumulative R&D Excellence Applications and Awards by Ethnicity for the 2001-2007 Period**



### **Award Budget Reductions**

Since the inception of the R&D Excellence program in 2001, the total number of applications submitted each year has increased. The following two tables demonstrate that the number of high quality applications received is increasing in parallel to the overall volume increase. In FY2005-06 KSEF made reductions to the requested budgets of the awards in order to fund as many of the high quality proposals as reasonably possible. In FY2006-07 the number of high quality fundable proposals was even larger and a budget broad budget reduction was not considered advisable. Only one award, presented to Pikeville College, was reduced to approximately one third of the requested funds (Table 4).

**Table 4. Amount of Award Reduction FY2006-07**

State Fiscal Year	Organization	Number of Awards	Total Amount Requested	Total Amount Awarded
FY 06-07	Pikeville	1	\$100,000	\$35,000
FY 06-07	UK	14	\$1,292,582	\$1,292,582
FY 06-07	UofL	1	\$98,970	\$98,970
<b>TOTALS</b>		<b>16</b>	<b>\$1,491,552</b>	<b>\$1,426,552</b>

Additional Fundable Projects

An additional 39 proposals presented for RDE-009 received qualifications of Very Good to Excellent but could not be funded due to insufficient funds. Consequently, for every one proposal funded in FY2006-07 another two qualified proposals could have been funded had the funds been available (Table 5). These proposals could have received consideration for a total funding amount of \$2.4 million. The quality of applications, as defined by nationwide reviewers, has never been the limitations to the growth of this program, rather funds have been limiting.

**Table 5. Number of Other Fundable Proposals FY2006-07**

State Fiscal Year	Organization	Number of Other Fundable Proposals	Amount Requested
FY 06-07	NKU	2	\$95,047
FY 06-07	UK	25	\$1,392,093
FY 06-07	UofL	12	\$913,775
<b>TOTALS</b>		<b>39</b>	<b>\$2,400,915</b>

**Achieving Completion**

All awards from six of the ten rounds of funding have completed the requirements and work proposed on the agreements (Table 6). Once an award is completed KSEF continues to track it for five years. KSEF expects the impact of the projects to create improvements in the knowledge base (publications, presentations, and training of students and post doctoral fellows), advancement and expansion of science and technology (acquiring of additional funding) and the opportunity to improve the economy (intellectual property and commercialization). Table 7 summarizes the information concerning statistics on the completion of these projects at the close of this fiscal year. Section 5 offers more details on the impacts that have been created to date.

**Table 6. R&D Excellence Awards: Number of Completed Projects**

Funding Round #	Year Projects Began	Number of Awards	Number of Projects Completed (as of June 30, 2007)
RDE-001	2002	32	32
RDE-002	2003	11	11
RDE-003	2003	32	32
RDE-004	2003	9	9
RDE-005	2004	31	28
RDE-006	2004	11	11
RDE-007	2005	20	9
RDE-008	2005/2006	31	7
RDE-009	2006/2007	16	0
EKU-KSEF-001	2004	2	2
<b>TOTALS</b>		<b>195</b>	<b>141</b>

## 5. IMPACT OF R&D EXCELLENCE AWARDS

The following impacts are a cumulative summary from the beginning of the KSEF program in 2001 until the end of this fiscal year (June 30, 2007).

### Follow-on Leveraged Funds

Amongst the objectives of KSEF awards is to help faculty in Kentucky secure extramural, non-state, funds. Since the inception of the program, KSEF awardees have received, collectively, more than \$93.5 million dollars from federal (92%), industrial (5%) and private (3%) sources (Table 7). Awardees have submitted 724 proposals for a total of more than \$502 million with a success rate of 32% (234 funded applications) This represents a return on the initial investment of approximately \$11 million (Table 3) more than \$8.5 to \$1 awarded.

**Table 7. Leveraging of KSEF Grant Funds FY2002-07**

<b>Funding Agency</b>	<b>Number of Submissions</b>	<b>Proposals Submitted (Budget Requested)</b>	<b>Number Funded</b>	<b>Amount Leveraged</b>
NIH	157	\$167,075,471	44	\$29,150,707
NSF	238	\$197,605,701	53	\$19,312,839
DOE	59	\$43,629,319	25	\$15,131,882
DOD	38	\$18,995,445	12	\$8,274,933
DHS	6	\$4,778,901	5	\$5,450,107
Industrial	34	\$6,876,173	27	\$4,730,300
USDA	40	\$11,209,665	11	\$2,967,485
Private	79	\$12,857,549	27	\$2,587,292
NASA	25	\$13,625,879	17	\$1,941,048
DOT	1	\$1,500,000	1	\$1,500,000
VA	2	\$1,048,000	2	\$1,048,000
Other Federal	16	\$12,579,232	2	\$904,523
EPA	6	\$881,132	2	\$285,000
ACS-PRF	11	\$809,131	4	\$245,000
DHHS	3	\$5,128,266	0	
DOEd	4	\$2,923,844	0	
USAID	1	\$500,000	1	
Dept. Treasury	1	\$225,000	1	
HUDA	1		0	
USGS	2		0	
<b>SubTotals:</b>	<b>724</b>	<b>\$502,248,708</b>	<b>234</b>	<b>\$93,529,116</b>
<b>EPSCoR Awards *</b>				
NSF EPSCoR	16	\$37,302,909	5	\$11,685,125
DEPSCoR	14	\$7,316,610	2	\$835,442
NASA EPSCoR	12	\$391,157	12	\$391,157
DOE EPSCoR	7	\$16,685,276	2	\$2,065,000
<b>SubTotals:</b>	<b>49</b>	<b>\$61,695,952</b>	<b>21</b>	<b>\$14,976,724</b>
<b>Totals:</b>	<b>773</b>	<b>\$563,944,660</b>	<b>255</b>	<b>\$108,505,840</b>
* Awards contain a mixture of State and Federal Funding				

### **Intellectual Property Development & Technology Transfer**

As per the reported numbers, KSEF awardees have submitted 51 invention disclosures, nine provisional patent applications and 36 Patent Applications, and have been issued 14 patents based on the results obtained in the KSEF-awarded grant work from 2002-2007.

Several technology transfer activities were reported during FY2006-07. Eleven awardees reported 14 fruitful attempts to transfer their technologies to eight different companies in Kentucky and elsewhere in the USA.

### **Presentations and Publications**

KSEF awardees have made 1,665 presentations at scientific meetings at the local, national and international level. These meetings were held in 45 states, Washington D.C. and 34 countries that included Australia, Belgium, Bosnia & Herzegovina, Brazil, Canada, China, Cyprus, Czech Republic, Denmark, England, France, Germany, Greece, Hong Kong, Hungary, India, Italy, Japan, Korea, Mexico, New Zealand, Oman, Poland, Portugal, Russia, Scotland, Slovenia, South Africa, Spain, Switzerland, Taiwan, The Netherlands, Turkey and the United Kingdom.

The awardees have submitted 1,264 research manuscripts for publication. Of these, 933 have been accepted in various journals in their area of work and an additional 288 are currently pending for publication. Forty-Three (43) books and/or book chapters have been published or are being published by the awardees.

### **Training of Graduate Students and Postdoctoral Scientists**

Five hundred forty eight (548) people are being trained on projects supported by the KSEF grants. This includes 164 postdoctoral scientists, 115 undergraduate students, 253 graduate students, five high school students, one science teacher and 11 other research personnel.

## **6. HUMAN RESOURCE DEVELOPMENT PROGRAM**

### **Critical Technology Institute / Survey of Science Teachers**

We continued to share the survey findings in our discussion to various groups inviting suggestions for the next step. In June 2004 KSEF/KSTC released the results of the "Kentucky Survey of Critical Technologies", a study conducted by Horizon Research International dealing with the depth of knowledge and understanding that Kentucky science teachers possess concerning critical technologies and concepts that are forming the basis for much of the advances in science and technology as well as new job creation. These technologies and concepts included nanotechnology, biotechnology, bio-defense, natural products, proteomics, alternative fuels, astrobiology and quantum computing, and were representative of five broad areas being targeted for investments in Kentucky. The findings demonstrated consistently, across five broad areas, a general awareness of a limited number of terms but showed that far fewer teachers understood a given concept well enough to present it in the classroom. In fact, over two-thirds of the concepts were only taught by fewer than ten percent of the teachers. Of the remaining one-third of the concepts, only one was taught by any more than 26 percent of the teachers.

In the coming year, we plan on identifying programs and partners that may offer opportunities to enhance knowledge base of science and math teachers in regard to critical technologies.

## Kentucky Satellite – KentuckySat (KySat)

KSEF/KSTC partnered with state agencies, universities and others in creating the KentuckySat Program (KySat), a joint enterprise led by the Kentucky Science and Technology Corporation (KSTC). The primary mission of KySat is to train students in the dynamics of spacecraft design, construction, launch and operation and to support accompanying education and research applications. This program allows Kentucky students to design, build, launch and ground operate small satellites for education, research and economic innovation purposes. At the end, this initial but critical hands-on experience is expected to motivate these young minds to become productive entrepreneurial engineers and scientists who will be ready to accept any scientific and engineering challenge.

KySat is a Pico class cube-shaped satellite with a mass of less than one kilogram and measuring only 10 centimeters in height, width and depth. Once successfully in orbit, KySat will be made available to Kentucky students, teachers, schools, universities, etc. for educational and research uses which include communications capability, temperature monitoring, current, voltage and science sensors, and photography using an onboard camera. It provides an open opportunity for students to think, research, design and construct a satellite that will use their engineering, communication and scientific creative knowledge in delivering a useful educational tool. KySat will involve an ongoing series of satellite design, build and launch missions – each with varying scope and complexity.

During this past year, KySat-1 Team made significant achievements on the project. Major KySat associated progress included:

### 1. 10-Week Students Training in California

The rigorous learning and training opportunity provided to KySat-1 Designed Team for ten weeks in California at Stanford Space and Systems Development Laboratory (SSDL) at Stanford University and NASA Ames Research Center helped the team to focus on their goal of developing an engineering model of KySat-1. The team learned to ask and discuss the right questions. They learned individual responsibilities and interdependence for achieving the goal. Each member also learned how to be resourceful to meet the need.

### 2. First KySat Conference

The first KySat conference was held in Lexington, KY on May 3, 2007. The conference was attended by nearly 100 people including students. The conference deliberated on inaugural orbital KySat Mission and the broader space, science and engineering issues. It featured three space leaders and other speakers:

- Scott Hubbard – Carl Sagan Chair for the Study of Life in the Universe, SETI (Search for Extraterrestrial Intelligence) Institute
- Bob Twiggs, Director Space Systems Development Laboratory, Stanford Aeronautics and Astronautics, Stanford University
- Greg Schmidt, Associate Director for Strategic Planning, Space Directorate, NASA Ames Research Center
- Kris Kimel, President, Kentucky Science and Technology Corporation, and
- The KySat-1 Student Team

### 3. Completion of the Engineering Model of the Cube Sat

An engineering model of the KySat-1 has been completed on time with all the necessary components. It has been shared with all the Consortium members. The weight of the engineering model was within the limit of one kilogram.

#### 4. Announcement of KySat-2 Student Design Team

The KySat-2 Design Team was selected through a competitive process. The recruitment was publicized among educational institutions in Kentucky. Applications were received and reviewed by the Consortium members. During the final selection, it was made sure that all necessary expertise would be met by the selected team members.

#### 5. Integration of KySat-1 and KySat-2 Teams and Project Review Meetings

KySat-1 and KySat-2 students met at the University of Kentucky (Faculty Advisor – Dr. James Lumpp) on May 21-25 and at Morehead State University (Faculty Advisor – Dr. Benjamin Malphrus) on June 11-15, 2007 for reviewing the progress made by KySat-1 team and for integrating the KySat-2 team. The KySat-2 Student Team includes: Keith Bux (MuSU), Jennifer Carter (MoSU), Garrett Chandler (UK), Andrew Crowe (MoSU), Thomas Dodson (UK), Tyler Doering (UK), Prabhakara Rao Eluru (MoSU), Daniel Erb (MuSU), Michael Gailey (UK), Chris Gleim (UofL), Samuel Hismeh (UK), William Hutchinson (UofL), Dale McClure (UK), Prasanna Padmanabhan (UK), Michael Shulte (KCTCS), VamshiReddy SinghiReddy (WKU), and Amber-Rose White (MuSU).

#### 6. KySat-2 Team Work Session In California

The KySat-2 Design Team spent two weeks from June 16 – July 1, 2007 at KSTC's Office of Advanced Concept at NASA Ames Research Center to work on the project. During this period, the team visited Stanford University, Space Systems LORAL, Cal Poly Labs and NASA Ames Research Center. The group also attended a short course on Systems Engineering (given by Bruce Pittman) and a NASA Small Space Industry Day. Faculty advisors, Drs. Ben Malphrus (MoSU), Jim Lumpp (UK) and Mahendra Jain (KSEF/KSTC), were present to assist and facilitate the team during a part or the entire period of this visit.

#### 7. Construction of Kysat-1 Flight Model

Since the completion of engineering model of KySat-1, the design team is now concentrating on developing a flight model for launch in 2008.

#### 8. Dual-Credit Course on 'Introduction to Space Flight Design and Flight'

Bob Twiggs is developing a college-level course "Introduction to Space Flight Design and Flight" that will offer dual-credit. This course will prepare students for undertaking projects such as KySat in the future.

#### 9. Space Express Mission

The KySat Express mission was created to get the whole KySat Consortium a quick experience to space. The primary objective of this mission is to learn and prepare for the KySat-1 launch but it will also offer a media impact for the student community, stakeholders and the state. At the end of this mission, the KySat Designed Team will answer two questions: Did they go to space and what made it work? The lessons learned from this project will be very crucial for the 2008 launch.

The KySat partnership is comprised of the University of Kentucky, Morehead State University, University of Louisville, Western Kentucky University, Murray State University, Kentucky Space Grant Consortium, Council on Postsecondary Education, KSEF and KSTC, which is the managing partner. The collaborations among the postsecondary institutions result from the Kentucky Council on Postsecondary Education's Strategy for Statewide Engineering Education. The multi-layered engineering strategy is designed to increase the number of engineers in the

state to boost the state's economic competitiveness and to address regional issues of access and productivity in engineering education. Lead mission partners in the KySat Program include Stanford Space and Systems Development Laboratory (SSDL), NASA Ames Research Center, KatySat ("Kids Aren't Too Young for Satellite") and California Polytechnic State University, which will serve as the launch integrator. Kentucky Virtual University is the virtual network partner maintaining remote communications among the partners.

## **7. KSEF TECHNOLOGY CAPACITY BUILDING PROGRAM**

### **Kentucky SBIR/STTR Program**

Prior to 2002, when KSTC began initiatives to promote the SBIR/STTR Program through the KSEF, there was no coordinated state-level activity to promote and provide assistance to Kentucky entrepreneurs and small tech businesses to access these extensive federal programs. With the proactive assistance from the state and the two federal grants, Rural Outreach and FAST (Federal and State Technology Partnership) from the U.S. Small Business Administration (SBA), KSTC developed a Kentucky SBIR/STTR Program by creating a basic infrastructure, outreach program and pre-award grant program that has helped the Kentucky small businesses immensely. In three years, the number of application submissions increased from 48 in 2002 to 80 in 2005, and 126 by 2007 because of KSEF's initiatives. In general, the Kentucky SBIR/STTR assistance program has resulted in following activities:

#### **Developing a Foundation for Providing Technical Assistance**

When it is determined that a company is unclear about its emerging technical idea, KSEF helps the company in refining and simplifying the idea. This is done through individual meetings. KSEF also directs the ideas to experts at the Kentucky universities to receive a feedback from the technical experts. Thus, the assistance allows development and expansion of an early-stage idea that can be developed into a SBIR application. The not-well-thought-out ideas are screened out from the SBIR process until more information can be obtained. KSEF has worked with several technical experts during the past four years and considers them as a resource for our tech businesses. Businesses are also guided through literature and patent search process.

#### **Building Partnerships**

KSEF has been helping companies in locating experts at Kentucky research universities to build partnerships. KSEF also works with faculty who may be interested in working with a company. Such relationships help them in developing a STTR application. Technical experts have also helped businesses in developing a research plan and have offered themselves to be a consultant on the proposed project under SBIR or STTR program.

#### **Outreach Activities (Conferences and Proposal Development Workshops)**

KSEF begins its outreach activities through telephone calls, site visits for discussions, developing and mailing SBIR related flyers, attending and speaking at events, and by organizing statewide SBIR conferences. These activities have helped KSTC in educating people and answering questions about the SBIR/STTR program. The one-on-one meetings help to determine the fit with the SBIR or STTR program and to teach how to navigate the SBIR Process. KSEF and its partners around the state (including universities, Chambers of Commerce, state agencies, ICC/IC Network and SBDC Network amongst others) have promoted the outreach events since 2002. The SBIR/STTR conferences were organized mainly in Lexington and Louisville (see Table 8) because of the limited travel and time commitment from the Federal SBIR Program Managers.

Since the SBIR/STTR grants are awarded on a competitive basis, it is important that a high quality, competitive proposal be submitted by the applicant. Businesses need coaching on proposal preparation. KSEF has also offered several Phase I proposal development workshops through external service providers (See Table 8). By using different professional service

providers, KSEF has learned different ways of tackling the same problem. Writing a SBIR proposal requires a unique approach; one has to keep a balance in writing to make sure the review panel buys the company's idea. Therefore, while writing about technology and commercialization is a key, it is also important to understand what reviewers may be looking for. By working with several service providers, KSEF has a good understanding of the Program and what each agency looks for in a successful proposal. For example, while proposals are reviewed by an external panel for NIH (granting agency), these are reviewed by an internal panel in the case of DoD (contracting agency). Thus, proposals have to be written with a different focus in these two cases.

Therefore, in addition to the conferences given by the Federal Program Managers, several proposal development workshops were organized on a statewide basis. Basic SBIR and STTR information was covered in these workshops with the attendees, and they were then taught how they can develop their Phase I proposals. A summary of activities undertaken since 2002 is presented in the following table:

**Table 8. Kentucky Outreach Activities for SBIR/STTR Program**

<b>Fiscal Year</b>	<b>Activity</b>	<b>Location &amp; conferences</b>	<b># of KY Attendees</b>	<b>Provider</b>	<b>Organizer</b>
2001-02	SBIR/STTR Conference	Lexington-1 Louisville -1	114	Fed Program Managers	KSTC/KSEF
02-03	NASA SBIR/STTR	Louisville	94	NASA SBIR Program Manager	KSGC and KSTC/KSEF
02-03	SBIR/STTR Conference	Lexington -1 Louisville -1	84	Fed Program Managers	KSTC/KSEF
03-04	SBIR/STTR Conference	Lexington -1	89	Fed Program Managers	KSTC/KSEF
04-05	SWIFT V SBIR/STTR Conference	Louisville -1	89	Fed Program Managers	KSTC/KSEF
04-05	SBIR/STTR Conference	Lexington	70	Fed Program Managers	KSTC/KSEF
05-06	National SBIR/STTR Conference	Louisville - 1	170+ (Total 710+)	Fed Program Managers	KSTC /Fed Agencies
<b>06-07</b>	<b>SBIR/STTR Conference</b>	<b>Lexington</b>	<b>43</b>	<b>Fed Program Managers</b>	<b>KSTC /KSEF</b>
02-03	SBIR Bidders Course and Workshop	Louisville -1	23	John Davis & M. Jain	KSTC/KSEF
03-04	Proposal Writing Workshops	Lexington -1	50	Jim and Gail Greenwood & M. Jain	KSTC/KSEF
04-05	Proposal Writing Workshops	Louisville	45	Jim and Gail Greenwood & M. Jain	KSTC/KSEF
04-05	Train-the-Trainers SBIR Workshop	Louisville	9	Robert Berger	KSTC/KSEF
04-05	Winning Proposal Preparation Workshops	Louisville B.-Green Lexington	74	Robert Berger & M. Jain	KSTC/KSEF & ICC (West)

04-05	SBIR/STTR for Univ. Faculty	University of Kentucky -2	30	Robert Berger & M. Jain	UK and KSTC/KSEF
05-06	Winning Proposal Preparation Workshops	Erlanger Louisville Murray	45	Robert Berger and Greenwood & M. Jain	KSTC/KSEF ICC (Central and West)
05-06	SBIR/STTR for Univ. Faculty	University of Louisville	5	Robert Berger & M. Jain	UofL and KSTC/KSEF
05-06	Proposal Writing Workshops at the National SBIR Conference	Louisville-2	35	Robert Berger and Greenwood	KSTC/Fed Agencies
<b>06-07</b>	<b>Proposal Writing Workshop</b>	<b>Louisville</b>	<b>14</b>	<b>Lisa Kurek</b>	<b>KSTC/KSEF</b>
<b>06-07</b>	<b>Winning Proposal Preparation Workshops</b>	<b>Lexington</b>	<b>22</b>	<b>Bob Berger &amp; M. Jain</b>	<b>KSTC/KSEF</b>
<b>06-07</b>	<b>Proposal Writing Workshop</b>	<b>Lexington</b>	<b>22</b>	<b>Lisa Kurek</b>	<b>KSTC/KSEF</b>

**Proposal Review and Editing.**

KSTC has also assisted companies in reviewing and editing their first drafts of their Phase I proposals; however, companies are directed to technical experts for technical review of their proposals. In addition, the companies are also referred to external service providers for final review of their Phase I or Phase II proposal drafts.

**Table 9. Federal Agencies and Service Providers at Kentucky Conferences**

Year City		Federal Program Manager/Agency			
2002	Lexington	Bill Goldner/USDA Connie Jacobs/DARPA Maurice Swinton/SBA	J. Goodnight/NIH Terry Payne/DOE John Williams/DOD	Joe Henebury/DOT Winslow Sargeant/NSF	Dean Hudson/Army Joel Shealy/NASA
2002	Louisville	Bill Goldner/USDA Connie Jacobs/DARPA Maurice Swinton/SBA	J. Goodnight/NIH Terry Payne/DOE John Williams/DOD	Joe Henebury/DOT Winslow Sargeant/NSF	Dean Hudson/Army Joel Shealy/NASA
2003	Lexington	C. Cleland/USDA Sara Nerlove/NSF	Lee Elden/DOED Terry Payne/DOE	Kay Etzler/NIH Joel Shealy/NASA	Joe Henebury/DOT
2003	Louisville	C. Cleland/USDA Sara Nerlove/NSF	Lee Elden/DOED Terry Payne/DOE	Kay Etzler/NIH Joel Shealy/NASA	Joe Henebury/DOT
2004	Lexington	Charles Cleland/USDA Sara Nerlove/NSF	Lynn Garrison/NASA Terry Payne/DOE	Ralph Helmsen/NIH John Williams/DOD	Dean Hudson/Army
2004	Louisville (SWIFT)	Jim Chern/NASA Sara Nerlove/NSF Tim Sharp/DHS	J. Goodnight/NIH Terry Payne/DOE Otho Thomas/Army	Steve Guilfoos/USAF Larry Pollack/CBD Carol Van Wyk/Navy	Joe Henebury/DOT Nora Savage/EPA
2005	Lexington	Lynn Garrison/NASA Terry Payne/DOE	Dean Hudson/Army Timothy Sharp/HSARPA	Len Moore/Air Force Kathleen Shino/NIH	Sara Nerlove/NSF
2006	Louisville (Natl. SBIR Conference)	Vince Andres/NASA Carrie Davison/NSF Joseph Henebury/DOT Mitch Lasat/EPA Phyllis Mitchell/NIH Karen Pera/USSOC	Michael Caccuitto/DOD J. Goodnight/NIH Connie Jacobs/DARPA Sonya Lucas/NSF Muralidharan Nair/NSF Thomas Piazza/USSOC	Charles Cleland/USDA Charles Griffin/NASA Larry James/USDOE Winfield Mexcur/NASA Kesh Narayanan/NSF Daniel Pitkin/NIST	Sabrina Davis/USAF Ralph Helmsen/NIH Eric Johnsen/NASA Eugene Mirvis/NASA Terry Payne/DOE Angelo Ponirakis/Army

	Susan Pucie/NIH Lee Rosenberg/MDA Kenneth Strayer/Army Ted Williams/NIH	Gerald Raisanen/Army Julie Scott/USDOE Andy Talbert/MDA Michael Zammit/MDA	John Ramsey/DARPA Tim Sharp/DHS Otho Thomas/Army Brenda Zimmer/ USFDA	Jonathan Root/NASA Susan Smith/USAF Tab Wilkins/NIST
2007 Lexington	Larry Boerboom/NIH Murali Nair/NSF Dionne Toombs/USDA	Jim Chern/NASA Terry Payne/DOE	Steve Guilfoos/ USAF Elissa Sobolewski/DHS	Connie Jacobs/DARPA Otho Thomas/Army

### **National SBIR Conference, Research Triangle Park, KY**

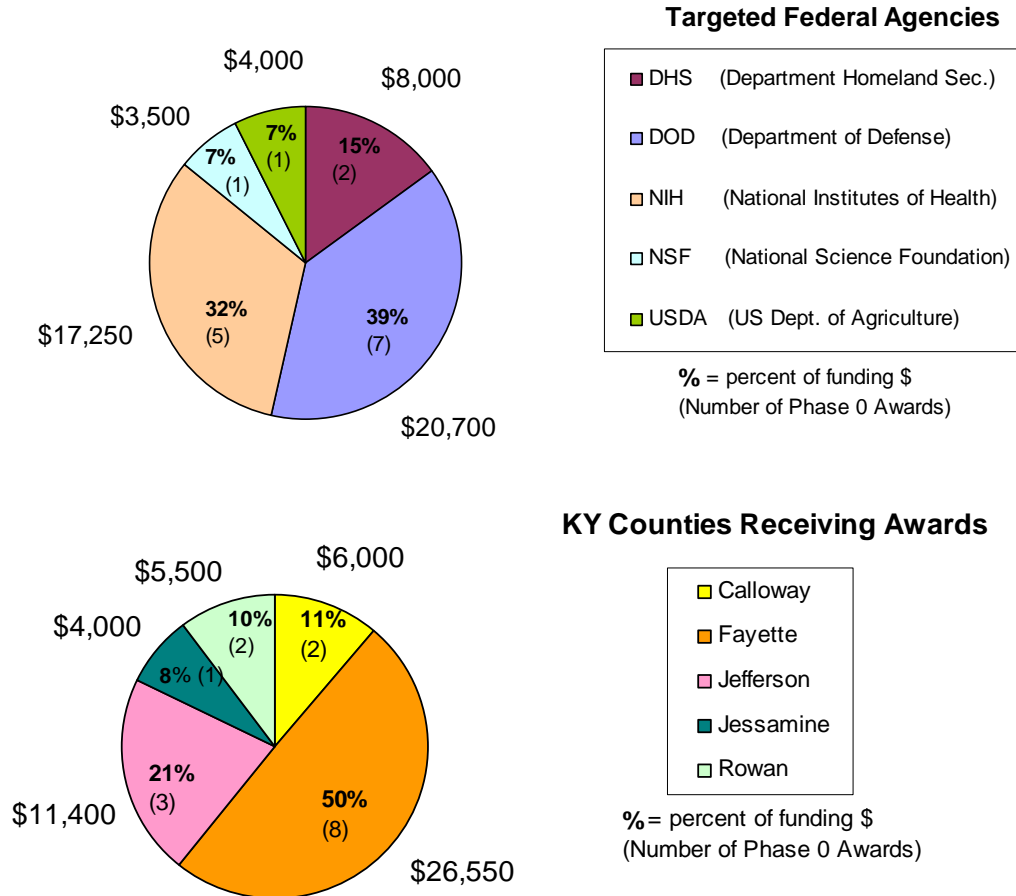
The KSEF/KSTC participated in the National SBIR Conference on April 30 to May 3, 2007. Kentucky's SBIR Phase Zero and Double Zero grant programs and other SBIR assistance to Kentucky's entrepreneurs were presented at the both.

### **Kentucky SBIR/STTR Phase Zero and Double Zero Grant Programs**

The **Kentucky SBIR/STTR Phase Zero and Double Zero** grant programs are resources for Kentucky's small businesses and university affiliated small businesses involving faculty. The funds are earmarked for the development of Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Phase I and Phase II proposals for submission to any of eleven participating federal agencies. The goal of the SBIR/STTR Phase Zero and Double Zero programs is to help Kentucky's new and existing small businesses compete more effectively and increase participation in federal SBIR and STTR programs by providing a seed grant to develop concepts and to prepare high-quality, competitive proposals. Up to \$4,000 can be awarded to a successful applicant. The applications are accepted throughout the year. KSEF has developed an on-line application process for both the Phase Zero and Double Zero programs. The applications are reviewed by a panel of reviewers and a decision is generally made in a six-week period. Half of the grant amount is provided upon signing the grant agreement and the other half is provided upon submission of a Phase I or Phase II SBIR or STTR application to a federal agency.

During this fiscal year, thirteen SBIR and three STTR Phase Zero grants (sixteen total) were awarded for a total of \$53,450 (Figure 9). Adding to this total, businesses provided a cost share in the amount of \$104,405. Geographically, the awardees were located in six counties that included Calloway, Fayette, Jefferson, Jessamine, and Rowan. The targeted federal agencies included the National Institutes of Health (five awards), Department of Defense (seven awards), US Department of Defense (two awards), US Department of Agriculture (one award), and the National Science Foundation (one award). Awards were used to prepare, review and submit fourteen proposals SBIR Phase I, while the remaining three awardees submitted STTR Phase I proposals.

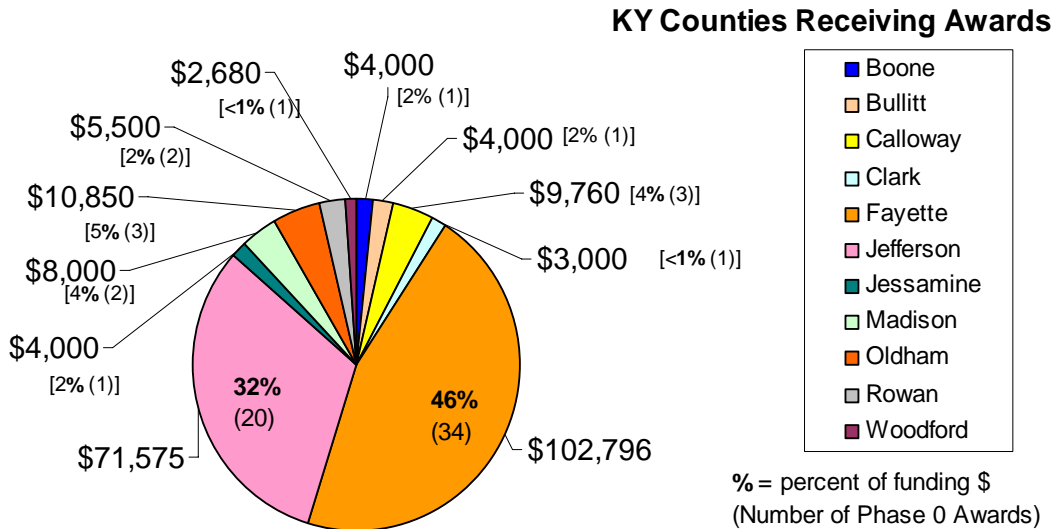
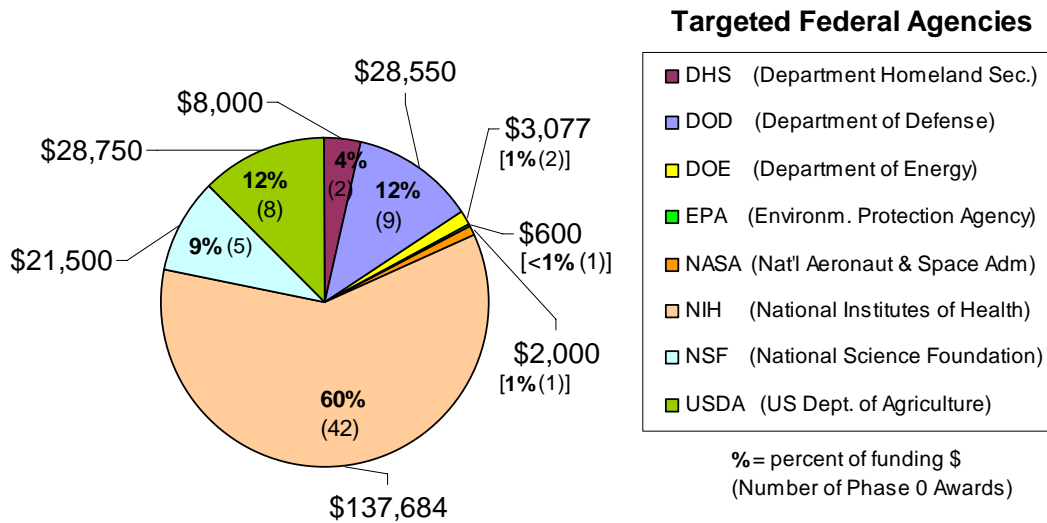
**Figure 9. Kentucky SBIR/STTR Phase Zero & Double Zero Awards FY2006-07**  
by Targeted Federal Agencies and Counties



<b>2006 - 2007</b>	<b>Total Funding: \$53,450</b>	<b>Proposals Funded: 16</b>
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Since the inception of the SBIR/STTR Phase Zero and Double Zero programs in October 2002 and up to June 30, 2007, seventy (70) awards have been made totaling \$230,161 (Figure 10). Adding to these awards, businesses have provided a cost share in the amount of \$442,208. The awards were made to businesses located in 12 Kentucky counties. From these awards, a total of 67 Phase I applications (51 SBIR and 16 STTR) and three Phase II STTR were submitted. The targeted federal agencies include the National Institutes of Health (42 applications), the United States Department of Agriculture (eight applications), the National Science Foundation (five applications), the Department of Energy (two applications), Environmental Protection Agency (one application), the Department of Defense (nine applications) and the National Aeronautics and Space Administration (one application). Although the outcome of 14 of the 67 Phase Zero submissions are still pending at the time of this report, eleven companies that received Phase Zero grants have received SBIR (six) or STTR (five) Phase I grants from various federal agencies for a total of over \$1.75 million. At least one of the three STTR Phase Double Zero awardees has received notification of their award and will be receiving more than \$361,000 from the National Institutes of Health.

**Figure 10. KY SBIR/STTR Phase Zero & Double Zero Awards 2002 - 2007**  
by Targeted Federal Agencies and Counties



<b>2002-2007</b>	<b>Total Funding: \$230,161</b>	<b>Proposals Funded: 70</b>
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### SBA Federal and State Technology (FAST) Partnership Program

The SBIR/STTR outreach efforts designed and developed under the FAST program to stimulate economic development among small and high technology businesses through federally funded innovation and research and development programs like the Small Business Innovation Research (SBIR) and Small Business Technology Transfer Research (STTR) programs were continued during this year.

KSEF has aggressively stepped up the SBIR/STTR awareness program including the proposal preparation workshops in addition to the assistance provided through ICCs and the Kentucky Enterprise Fund programs. The new Kentucky SBIR/STTR Matching Funds Program (funded by the Kentucky Cabinet for Economic Development, Department of Commercialization and Innovation, and administered by the Kentucky Science and Technology Corporation) is providing further stimulus to tech businesses in taking their innovations to commercial world.

### **Institute for Sub-Surface Exploration (ISSE)**

Through its Office of Advanced Concepts at NASA Ames Research Center at Moffett Field, CA, KSTC/KSEF has continued its partnership with the NASA Ames in furthering the mission of the Institute for Sub-Surface Exploration (ISSE). The mission statement of the ISSE, developed at the initial workshop, remained: To advance the science, technology and processes needed for planetary sub-surface exploration, access and development.

During this past year:

- The on-going ISSE related R&D activities, funded under the KSEF R&D Excellence Program, continued.
- ISSE Technology Roadmap R&D project was designed.
- The Technology Roadmap project was funded and began.
- Planning for 2007/2008 Asteroid Mining Workshop was initiated.
- Collaboration between Kentucky and NASA Scientists/Engineers was facilitated.

The ISSE has opened new research and development opportunities for Kentucky university faculty and businesses. KSTC continued its efforts in bringing the experts together to define the scope of ISSE and in making them aware of collaborative and funding opportunities.

The emerging priority for sub-surface exploration is being driven both by In-Situ Resource Utilization and other scientific interests for Lunar exploration as well as astrobiology interest for Mars exploration. Additional science and applications considerations are also important; research and development outcomes from the ISSE could have important terrestrial applications, for instance in the mining industry. Astrobiology has already been identified by KSEF as one of the niche areas for consideration under the R&D Excellence Program.

This new partnership builds upon the exciting projects with NASA currently ongoing through work at Kentucky universities and further creates whole new opportunities for Kentucky scientists, faculty, entrepreneurs, teachers and students.

For example, during this year, KSEF facilitated a potential collaboration between one of its awardees, Dr. I.S. Jawahir of the University of Kentucky, and NASA Ames Research Center scientists on ISRU Characterization Experiment – Astrobiology eXplorer (ICE-AX) under the Innovative Partnership Program – Partnership Seed Fund Proposal-2007. The ICE-AX proposal proposes to advance the Technology Readiness Level (TRL) of a mission and payload to search for biosignatures and characterize water resources on Mars. The proposal team plans to develop a prototype (currently TRL3) low mass 10 m-depth tethered drill and test it under Martian pressure/temperature conditions by drilling into a 10 m column of simulated Martian permafrost, advancing its TRL to 6. The project is led by NASA scientists and engineers – Carol Stoker, Jeff Brown, Andrew Gonzales and Nathan Bramall with David Smith (The Boeing Company), George Cooper (Professor Emeritus – UC Berkeley), Scott Stanley (Alliance Space Systems, LLC), B. Price (Professor, UC Berkeley), R. Elphic (Los Alamos National Lab) and I.S. Jawahir (Professor, University of Kentucky). In this proposed project, Dr. Jawahir will develop and test drill bits.

In general, the NASA Ames partnership includes the pursuit of work in living systems, information systems, automation, nanotechnology and celestial mining. As part of this effort, KSTC is providing access for Kentucky faculty, companies and students at the NASA Ames Research Center. Further, KSTC through its office at ARC continues to work with the businesses and VCs network in the Silicon Valley area exploring opportunities for Kentucky's

existing and new businesses, and KSEF has established a Specific Target Areas for grants in astrobiology.

### **Leveraged Funds**

Thus far, a total of \$595,975 has been leveraged for the technology capacity building program. This includes \$393,583 in contracts and grants from NASA SERTTC at Georgia Institute of Technology and the U.S. Small Business Administration for tech transfer and SBIR/STTR program development activities, respectively; \$166,652 from private sources, Appalachian Regional Commission, and the Department of Commercialization and Innovation for Kentucky and National SBIR Conferences and SBIR/STTR proposal development workshops; \$13,000 in gifts from Lexmark; \$5,000 from the American Society for Microbiology as Indo-US International Professorship Award. The funds leveraged for the FY2006-2007 technology capacity building program include \$18,240 from private sources for the SBIR/STTR outreach activities including the Kentucky SBIR/STTR Conference and the proposal development workshops.

## **8. KSEF PROGRAM REFINEMENTS**

In the second half of FY2007 and in preparation for the launch the latest RFP, a completely web based application, reviewing and reporting platform was put in place. On April 19, 2007 applicants for RDE-010 awards submitted their letters of intent online, received notification of the status of their invitation (invited, not invited) online, and completed their proposal application online. Beginning FY2007, each PI possesses a unique set of ID and password on our KSTC database that can be used to access and obtain information on their activities with KSEF awards (e.g. reports due, application submissions, etc).

A tutorial for the online proposal submission platform was developed to aid applicants during the submission process. All proposals have been standardized to a defined format that is automatically generated with the information entered by the PI. This feature was developed to ameliorate problems encountered when transmitting proposal PDF to reviewers for their evaluation. Also, standardization of proposals eases the burden of reviewers having to evaluation KSEF applications, and eliminates biases caused by, for example, poor image quality, scanning errors, and different font size and type. The proposal format now better matches the headlines listed under the evaluation form. Evaluation sheets will eventually be synchronized to the PDF file to direct the reviewer to the correct sections to evaluate.

## **9. KSEF ADVISORY BOARD**

The 15 membership position/categories for the KSEF Advisory Board are allotted as follows: UK and U of L Research VPs (two), EPSCoR members from Comprehensive Universities (two), Independent Universities or Community College System (one), Corporate Sector (three), Business and Financial Sector (four, in which up to two shall represent from the Venture Capital community) and those with Science and Engineering Connections from outside Kentucky (three). The KSEF Executive Director serves as an ex officio, non-voting member.

The following 12 people comprise the current KSEF Advisory Board. Three positions in the Business/Financial Sector are vacant and one Out-of-State Academic expert position is vacant. In the list below, the year in parenthesis indicates the year in which current term expires. Subsequent terms are for three years.

**KENTUCKY SCIENCE & ENGINEERING FOUNDATION  
ADVISORY BOARD MEMBERS**

<b>University of Kentucky</b> Dr. Chuck Staben, VP Research UK Research and Graduate Studies 201 Gillis Building Lexington, KY 40506-0033 <a href="mailto:staben@email.uky.edu">staben@email.uky.edu</a> (No Term – by position)	<b>Corporate Sector/Business</b> Mr. L. Edward Givan, Operations Manager Raytheon Company 6201 Strawberry Lane Louisville, KY 40214 <a href="mailto:Louis_E_Givan@raytheon.com">Louis_E_Givan@raytheon.com</a> (2010)
<b>University of Louisville</b> Dr. Manuel Martinez-Maldonado, Executive VP for Research University of Louisville 202B Jouett Hall, Belknap Campus 2301 South Third Street Louisville, KY 40292 <a href="mailto:m0mart10@louisville.edu">m0mart10@louisville.edu</a> (No Term – by position)	<b>Corporate Sector/Business and Financial</b> Mr. Paul Kelley, VP of Manufacturing Martek Biosciences Corporation 555 Rolling Hills Lane Winchester, KY 40391 <a href="mailto:pkelley@martekbio.com">pkelley@martekbio.com</a> (2010)
<b>Comprehensive Universities</b> Dr. Blaine Ferrell, Associate Dean Western Kentucky University College of Science 104 Thompson Complex, Central Wing Bowling Green, KY 42101 <a href="mailto:blaine.ferrell@wku.edu">blaine.ferrell@wku.edu</a> (2010)	<b>Out of State Experts</b> Dr. Charles Wyman, Professor Dept. of Chemical/Environmental Eng. University of California-Riverside 900 University Avenue Riverside, CA 92521 <a href="mailto:charles.wyman@ucr.edu">charles.wyman@ucr.edu</a> (2008)
<b>Comprehensive Universities</b> Dr. T.S. Kochhar, Professor of Biology Kentucky State University 400 East Main Street Frankfort, KY 40601 <a href="mailto:tejinder.kochhar@kysu.edu">tejinder.kochhar@kysu.edu</a> (2009)	<b>Out of State Experts</b> Dr. Charles Kupchella, President University of North Dakota P.O. Box 8193 Grand Forks, ND 58202-8193 <a href="mailto:c_kupchella@mail.und.nodak.edu">c_kupchella@mail.und.nodak.edu</a> (2009)
<b>Private, Independent or Community College System</b> Dr. James Miller, Professor Transylvania University Computer Sciences and Mathematics 300 North Broadway Lexington, KY 40508 <a href="mailto:jmiller@transy.edu">jmiller@transy.edu</a> (2008)	<b>Out of State Experts – Corporate Business</b> Mr. Paul “Korky” Korkemaz Director, Civil Space Programs Honeywell Defense and Space 1001 Pennsylvania Avenue NW Suite 700-S Washington, DC 20004 <a href="mailto:paul.korkemaz@honeywell.com">paul.korkemaz@honeywell.com</a> (2009)
<b>Corporate Sector/Business</b> Mr. Edward McInerney, Retd. Chief Engineer General Electric Company Appliance Park Louisville, KY 40225 <a href="mailto:ejmcinerney@aol.com">ejmcinerney@aol.com</a> (2008)	<b>Ex-Officio</b> Dr. Mahendra Jain, Executive Director Kentucky Science and Engineering Foundation 200 West Vine Street, Suite 420 Lexington, KY 40507 <a href="mailto:mjain@kstc.com">mjain@kstc.com</a> (No Term - by position)

## 10. PRESS RELEASES AND PUBLIC AWARENESS

Fifteen press releases on events benefiting Kentucky scientists, engineers, entrepreneurs and tech businesses were issued by KSTC during FY2006-07. These include:

- 07-14-06 Promotion of *nanoTX'06* (Nanotechnology Conference and Trade Expo)
- 07-14-06 NIH Announcement for SBIR Commercialization Assistance Program
- 07-27-06 Solicitation Announcement for New Funding Opportunities in the Kentucky Commercialization Fund
- 08-28-06 Promotion of National SBIR Conference in Milwaukee, WI
- 10-02-06 Announcement: KSTC's Mahendra Jain Receives the 2006 National Tibbetts Award
- 10-02-06 Announcement: SBIR/STTR Proposal Preparation Workshops (Louisville with NIH Focus and Lexington with General Focus) Organized by KSTC-KSEF
- 02-12-07 Announcement: SBIR/STTR Conference and Workshop (Lexington) Organized by KSTC-KSEF
- 02-19-07 Announcement Reminder: SBIR/STTR Conference and Workshop (Lexington) Organized by KSTC-KSEF
- 02-26-07 Announcement Reminder: SBIR/STTR Conference and Workshop (Lexington) Organized by KSTC-KSEF
- 03-01-07 Announcement Reminder: SBIR/STTR Conference and Workshop (Lexington) Organized by KSTC-KSEF
- 03-19-07 Promotion of Spring 2007 National SBIR Conference in Durham, NC
- 04-02-07 Promotion Reminder of Spring 2007 National SBIR Conference in Durham, NC
- 04-13-07 Promotion Reminder of Spring 2007 National SBIR Conference in Durham, NC
- 04-27-07 Solicitation Announcement for New Funding Opportunities in Research and Development Excellence Program (Emerging Ideas Grant Category)
- 05-07-07 Announcement: NIST Advanced Technology Program (ATP) has Returned

Copies of all of the above press releases are included in the attachments section.

A KSEF program brochure is disseminated at every opportunity. KSEF website (<http://ksef.kstc.com>) is the main source of up to date information on request for proposals, funding guidelines and award announcements. In addition, the KSTC website (<http://www.kstc.com>) also provides a link to the KSEF site.

A web-based KSTC KIA database, with a word search function, helps further analyze the abstracts of each investment for trends in subject matter relevant to a given audience. It is user driven and available for searching all investments by word of interest such as terms of particular interest to Kentucky (i.e., coal, cancer, diabetes, tobacco, nano-scale projects, etc.). This is in addition to the focus area listings of all KIA investments, which are found in the attachment section.

## 11. Investment in People and Ideas

### Five Years Supporting Excellence in Research and Enabling Researcher Recognition

Universities and their faculty positively affect the image and reputation of the state's academic growth through three main sets of daily activities: teaching, research and communication of their findings. Few faculties are granted prestigious awards for their excellence in performing all three activities. Measures of such excellence are The National Science Foundation CAREER award, the level of extramural funding faculty receive, and the number of times their publications are cited by peers – measured by the Science Citation Index. Examples of these activities by KSEF R&D Excellence awardees are many and provided below.

### Recognition of Kentucky Researchers - National Science Foundation CAREER Award

The National Science Foundation (NSF) Faculty Early Career Development (CAREER) program was created to sustain and strengthen the Nations' science, mathematics and engineering capabilities. The program supports promising young scientists who have demonstrated a unique ability to integrate teaching and research activities within the context of the organization the work with. The NSF supports 300 to 400 new awards per year across institution in the US and Puerto Rico, typically ranging from \$300,000 to \$500,000 for a period of three to five years. An estimated 20% of proposal applications receive funds each year. Twelve NSF CAREER awards were received by Kentucky faculty between 2002 and 2007. Eight of this faculty have received R&D Excellence awards supporting the research leading to these CAREER awards (Table 10).

**Table 10: KSEF R&D Excellence Awardees who have received the National Science Foundation CAREER awardees between 2002 and 2007**

Awardee Name	Institution	CAREER Project Title	Amount Awarded	Support Period
Cindy Harnett	University of Louisville	CAREER: Ultra-Low Embedded Sensors for High-Density Remote Monitoring of Water Quality	\$405,686	2007-2012
Stephen Holmes	University of Kentucky	CAREER: Construction of Magnetic Cyanide-, Acetylde-, and Butadiynylde-Based Clusters	\$555,000	2007-2012
Michael Kalinski	University of Kentucky	CAREER: Understanding and Predicting the Dynamic Behavior of Mine Tailings Dam Materials	\$400,000	2005-2010
Hichem Frigui	University of Louisville	CAREER: A New Approach to Clustering Based on Synchronization of Coupled Oscillators with Application to Content Based Image Retrieval	\$750,000	2004-2008
Tongguang Zhai	University of Kentucky	CAREER: Quantitative Understanding of the Effects of Micro- and Macro-Texture on Fatigue Crack Initiation and Early Growth in High Performance Alloys	\$419,781	2007-2012
Ruigang Yang	University of Kentucky	CAREER: The Light Portal: 3D Reconstruction and Visualization Over Space and Time	\$380,000	2005-2008
Bruce Hinds	University of Kentucky	CAREER: Aligned Carbon Nanotube Composite Array as Permeable Membrane for Selective Chemical Separations and Sensing	\$483,214	2004-2009
Stephen Rankin	University of Kentucky	CAREER: Kinetics and Engineering of Functional Nanoscale Organic-Inorganic Hybrids	\$405,700	2004-2009
<b>TOTALS</b>			<b>\$3,799,381</b>	

### Kentucky Researchers Securing Long-Term Research Funding

Providing seed money for innovative research has been a prolific investment in Kentucky. Faculty supported by KSEF R&D Excellence awards have been successful at securing federal, private and industrial funds in all areas of research. Twenty-two of the 195 awardees have reached levels of funding equal or above \$1,000,000 as primary PI. Success rates for most funding programs from federal agencies for which our KSEF awardees compete are never higher than 20%; this exemplifies the efforts and level of competitiveness that Faculty in the Commonwealth of Kentucky have reached over the past five years. Examples of these meritorious individuals are listed in Table 11.

**Table 11: Extramural funding secured by KSEF R&D Excellence Awardees between 2002 and 2007**

Awardee Name	Extramural Funding Agencies	Total Extramural Funding
Kimberly Anderson	NASA, NSF	\$3,289,801
Rodney Andrews	DHS, industrial, Private	\$1,599,000
Dashzeveg Bayarsaihan	NIH	\$1,250,000
Zhi Chen	DOE, NSF	\$3,100,000
William Ehringer	NIH	\$1,634,820
Todd Hastings	NSF	\$1,600,000
David Hildebrand	DOE, EPA, USDA, Industrial, Private	\$907,339
Rick Honaker	DOE	\$989,096
Robert Lodder	NIH, NASA, Industrial	\$1,638,980
Guzngxiang Luo	NIH	\$2,637,447
Benjamin Malphrus	NASA	\$1,000,000
Madhu Menon	NASA, DOD, DOE	\$945,000
Timothy Miller	NIH, other	\$1,221,000
Royce Mohan	NIH	\$1,438,561
Fred Payne	DHS, USDA	\$1,000,000
Stephen Rankin	DOE, NSF	\$2,008,769
Kozo Saito	Industrial	\$1,540,000
Vijay Singh	NSF	\$2,130,000
Mahendra Sunkara	DOD, DOE, Industrial, Private, NASA	\$7,790,000
Daniel Tao	DOE, Industrial	\$9,894,429
Dong-Sheng Yang	ACS-PRF, NSF	\$1,000,407
Tonguang Zhai	DOD, NSF, Private	\$1,656,735
<b>Total</b>		<b>\$50,271,384</b>

### **Excellence of Kentucky Based Research - Impact of Academic Publications**

An indicator of the impact that academic publications have on the scientific community and on the trends and future of scientific research in the nation is the Science Citation Index (SCI). The SCI is the number of times a certain journal article or author/s has been referenced by peers in other publications. A sample of some of the most referenced KSEF R&D Excellence Awardees (including their collaborators) is provided in Table 12.

**Table 12: Extramural funding secured by KSEF R&D Excellence Awardees between 2002 and 2007**

Awardee Name	Primary Area of Research	Number of Citations of KSEF Award related work
Craig McClain	Human Health and Development	474
James Geddes	Biosciences	168
Theesa Chen	Human Health and Development	160
David Hildebrand	Biosciences	106
Teresa Fan	Biosciences	88
Guzngxiang Luo	Human Health and Development	86
Peter Nagy	Biosciences	78
Bruce Hinds	Material Science and Advanced Manufacturing	75
Clyde Holspapple	Information Technology and Communications	49
Barbara Knutson	Environmental and Energy Technologies	48
Chi-Sing Man	Material Science and Advanced Manufacturing	28
I.S. Jawahir	Information Technology and Communications	27
Peter Hardy	Biosciences	22
John Obrycki	Biosciences	18
Benjamin Malphrus	Information Technology and Communications	17
Daniel Tao	Environmental and Energy Technologies	11
<b>Total</b>		<b>1,455</b>

## 12. NEW KSEF STAFF

During this past year, two new KSEF staff members were hired. These included Debbie Rempfer and Dr. Maria Labreux. Their short bios are below:

### Debbie Rempfer:

Debbie joined the KSTC staff in August 2006 and is the Administrative Assistant for the Kentucky Science and Engineering Foundation (KSEF). She supports the KSEF Executive Director, and provides administrative assistance for the Kentucky Science and Engineering Foundation and Kentucky Commercialization Fund programs. Debbie's business experience includes executive support, publications, medical office support, personnel, benefits, and finance and policy administration. Her professional background includes working at Artemetrx,

CHA Health and the Center for Psychological Health before joining KSTC. In addition, she is a published author (David C. Cook Publishing Company) and worked as an editor for Bristol Books.

**Maria Labreuveux:**

Maria joined KSTC in February 2007 as the Program Manager for the Kentucky Science and Engineering Foundation (KSEF). Maria manages the Kentucky Science and Engineering Foundation and the Kentucky Commercialization Fund programs, for which KSTC receives funding from the Commonwealth of Kentucky through a contract with the Council on Post-Secondary Education. Maria brings research and grants management experiences from the Delaware State University (DSU) where she worked as an Assistant Professor before moving to Kentucky. Maria secured over \$2 million in 2.5-year period at DSU for her research and teaching from federal and state agencies such as the United States Department of Agriculture, National Resources Conservation Services (USDA-NRCS), the Cooperative State Research, Education and Extension Services (CSREES), the National Science Foundation (NSF) and University of Delaware. Dr. Labreuveux is an active member of the Early Career Professional Division of the Agronomy and Crop Science Societies of America and a contributor to the society's monthly newsletter. Maria received her PhD in Agronomy-Plant Science from The Pennsylvania State University, and her MS and Ag. Engineering degrees in Argentina.

### 13. PROFESSIONAL RECOGNITIONS

During this year, KSEF staff was invited to contribute to the following events:

- **DOE-USDA SBIR Energy Summit, Oak Ridge National Laboratory, Knoxville, TN, July 6-7, 2006** - Mahendra Jain participated in the session on "Focus on South East" and made a presentation on "Opportunities through Kentucky SBIR/STTR Grant Program".
- **High Impact Program, Greater Louisville Inc., Louisville, KY, October 19, 2006** – Mahendra Jain was invited to make a presentation on "Small Business Grants and the process for attaining them" at the High Impact Exchange event focusing on "Growth Capital: Discovering New Resources to Fund High Impact Businesses".
- **2007 Spring National SBIR Conference, Research Triangle Park/Durham, NC, April 30 – May 3, 2007** – Mahendra Jain served on the National SBIR Conference Planning Committee for 2007 Spring National SBIR Conference held at Research Triangle Park / Durham, NC. This was the first national conference that was organized without the support of federal funds. The conference went extremely well.
- **Workshop on 'Industrial Biotechnology – from the laboratory to the market place', Indian Institute of Technology-Madras, Chennai, India, December 27, 2006 – January 6, 2007.** Under the American Society for Microbiology International Professor Award (Indo-US ASM International Professor), Mahendra Jain, in collaboration with Dr. T. Chandra of IIT Madras, organized a workshop on "Industrial Biotechnology – from the Laboratory to the Market Place". The workshop was attended by 50 students from science and engineering disciplines. The workshop was funded by the Government of India – Department of Biotechnology (DBT), Mahendra gave following lectures at the workshop:
  - Concept of Taking Ideas to the Market Place (December 27, 2006)
  - Fermentative Production of Biochemicals (December 28, 2006)
  - Design and Development of Biocatalysts (December 30, 2006)
  - Programs for Knowledge Based Economic Development (January 5, 2007)
  - Feedback Responses (January 6, 2007)

- Mentoring of a group of students on 'Development of a Process and Commercialization Opportunities for Butanol Fermentation' (December 27, 2006 – January 5, 2007)
- **An Article for Early Career Members in CSA News, July 2007** – Mahendra Jain was invited to contribute an article for CSA News (a monthly magazine distributed to 11,000+ members of the American Society of Agronomy, The Crop Science Society of America and The Soil Science Society of America) under its 'Career & Education' section. His article "Be Your Own Boss – Take Your Research Idea to the Marketplace" was published in July 2007 CSA News V52 N07 P26.